(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 0 770 504 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
02.05.1997 Bulletin 1997/18

(51) Int Cl.6: B60C 15/05, B60C 15/024

(21) Application number: 96307614.6

(22) Date of filing: 22.10.1996

(84) Designated Contracting States:
DE FR GB

(30) Priority: 23.10.1995 JP 274398/95
28.11.1995 JP 309161/95
18.09.1996 JP 246288/96

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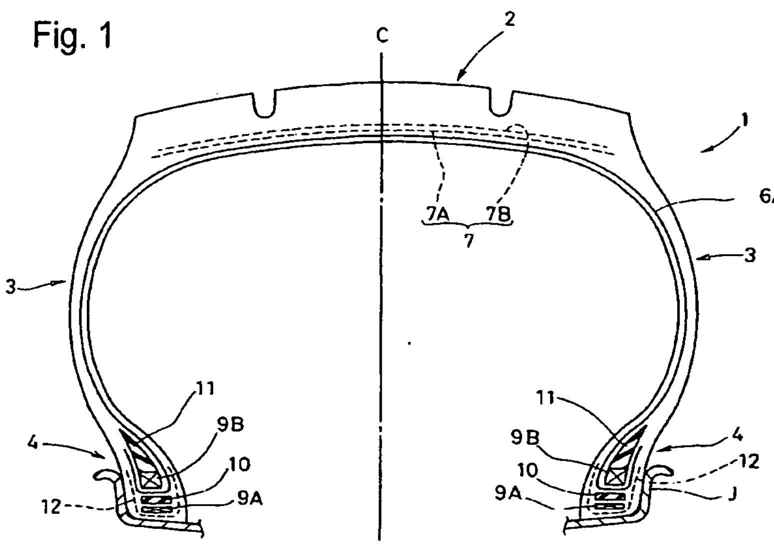
(54) Pneumatic tyre

(57) A pneumatic tyre comprises a radially inner bead core (9A) disposed in at least one of bead portions (4), a radially outer bead core (9B) disposed radially outside the inner bead core (9A), a buffer rubber layer (10) disposed between the radially inner bead core (9A) and radially outer bead core (9B) to provide a predetermined space therebetween, and a toroidal carcass (6) extending between the bead portions through the tread portion and sidewall portions, wherein the carcass comprises a ply of cords turned up around the radially outer bead core (9B) to be secured thereto, passing between the radially outer bead core (9B) and the buffer rubber layer (10), so that a radially outward tension of the carcass caused by tyre inflation acts less on the radially inner bead core (9A) than the radially outer bead core (9B). Therefore, the transmission of vibration from the tread portion to bead portion is effectively decreased to reduce road noise.

Fig. 1



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Printed by Jouve, 75001 PARIS (FR)

Description

The present invention relates to a pneumatic tyre with reduced road noise.

Road noise is an uncomfortable rumbling sound which may be heard in the inside of a car when running on relatively rough road surfaces. Such rough road surfaces vibrate the tread portion of the tyre, and the vibration is transmitted to the wheel rim, axis, suspension and body of the car and is then heard in the inside of the car as road noise.

In general, as shown in Fig.8, a pneumatic tyre is provided in each bead portion with a bead core (a), and a carcass (b) is secured to the bead core (a) by wrapping the core therein. When the tyre is mounted on a rim (j), the thin rubber layer (d) which exists between the carcass portion (b1) under the bead core (a) and the bead seat of the rim is compressed, and a tensile strain acts on the carcass. Therefore, with respect to the above vibration, the tyre is provided from the tread portion to the bead portion with a good conductivity.

In such a tyre, it is most effective for reducing the road noise to obstruct the transmission of vibration in the tread portion (the entrance for the vibration to the tyre), in other words at the boundary between the tyre and road surface.

Therefore, it has been proposed to use a soft tread rubber composition which is excellent at absorbing the vibration and/or to increase the tread rubber thickness. However, in those methods, other running performances are liable to be deteriorated. For example, in the former method the wear resistance of the tread greatly decreases.

On the other hand, as another method of obstructing vibration, it has been proposed to dispose a rubber composition, which is excellent at vibration absorption, along the outer surface of the bead portions which contact the rim flange. This method is however, insufficient as a road noise reducing effect.

It is therefore, an object of the present invention to provide a pneumatic tyre in which, by improving tyre reinforcing members such as a carcass, bead core and the like disposed inside the tyre, the transmission of vibration from the tread portion to bead portion is effectively decreased to reduce the road noise.

According to one aspect of the present invention, a pneumatic tyre comprises a tread portion, a pair of sidewall portions, a pair of bead portions, a radially inner bead core disposed in at least one of the bead portions, a radially outer bead core disposed radially outside the first bead core, a buffer rubber layer disposed between the radially inner bead core and radially outer bead core to provide a predetermined space therebetween, a toroidal carcass extending between the bead portions through the tread portion and sidewall portions, the carcass comprising a ply of cords turned up around the radially outer bead core to be secured thereto, passing between the radially outer bead core and the buffer rubber layer, so that radially outward tension of the carcass caused by tyre inflation acts less on the radially inner bead core than the radially outer bead core.

The thickness of the buffer rubber layer measured in the tyre radial direction is preferably in the range of from 2 to 6 mm.

Accordingly, the radially outer bead core functions as an anchor for the carcass. On the contrary, the radially inner bead core functions mainly to fasten the bead portion on the bead seat of a rim. Therefore, the radially inner and outer bead cores do not compress the buffer rubber layer in the tyre radial direction, as a result the buffer rubber layer functions as an ideal vibration isolator. Thus, the vibration which is mainly transmitted by the carcass is stopped at the outer bead core, and the transmission from the outer bead core to the inner bead core is hindered.

Embodiments of the present invention will now be described in detail in conjunction with the accompanying drawings, in which:

Fig.1 is a cross sectional view of a tyre showing an embodiment of the present invention;
Fig.2 is an enlarged cross sectional view of the bead portion thereof;
Fig.3 is a graph showing a relationship between the thickness of the buffer rubber layer and road noise reduction;
Fig.4 is a graph showing a relationship between the complex elastic modulus of the buffer rubber layer and road noise level;
Fig.5 is a cross sectional view of a tyre showing another embodiment of the present invention;
Fig.6 is a partial cross sectional view showing another embodiment;
Fig.7 is a partial cross sectional view showing another embodiment; and
Fig.8 is a cross sectional view showing a conventional bead structure.

In Fig.1, the pneumatic tyre 1 comprises a tread portion 2, a pair of axially spaced bead portions 4, a pair of sidewall portions 3 extending between tread edges and bead portions, a carcass comprising a carcass ply 6A extending between the bead portions 4 through the tread portion 2 and the sidewall portions 3, and a stiff belt 7 disposed radially outside the carcass ply 6A and inside the tread portion 2 to provide a hoop effect on the carcass ply 6A.

The tyre in this embodiment is a passenger radial tyre whose aspect ratio is 0.65.

The carcass in this embodiment consists of only one ply 6A. The carcass ply 6A is made of carcass cords arranged radially at an angle of from 65 to 90 degrees, in this embodiment 90 degrees with respect to the tyre equator C. For the carcass cords, organic fibre cords, e.g. nylon, rayon, polyester or the like are preferably used, but steel cords can

be also used.

The belt 7 comprises at least one ply of belt cords. In this embodiment, the belt 7 comprises a radially inner ply 7A and a radially outer ply 7B.

The belt cords in each ply 7A and 7B are laid at an angle of from 10 to 35 degrees with respect to the tyre equator C in parallel with each other but crosswise to the cords of the adjacent ply.

For the belt cords in this embodiment, metal (steel) cords are used, but relatively high elastic organic fibre cords such as rayon and the like may be used. In each of the bead portions 4, a radially inner first bead core 9A and a radially outer second bead core 9B are disposed. The second bead core 9B is disposed radially outside of and concentrically with the first bead core 9A.

The first bead core 9A is to ensure the engagement between the tyre and rim. Thus, the diameter and position thereof are so defined. The first bead core 9A is disposed within a range which corresponds to the height H of a flange of a standard rim J for the tyre.

The above-mentioned carcass ply 6A is turned up around the second bead core 9B in each of the bead portions from the axially inside to outside of the tyre to be secured thereto. In this case where a single carcass ply is used, it is preferable that the radially outer surface of the second bead core 9B does not extend higher than the height H of the flange of the rim J.

In this embodiment, the first bead core 9A and the second bead core 9B are substantially aligned in the tyre axial direction.

It was confirmed that, for a tyre size of 185/65R14 which is the size of this embodiment, a sufficient tyre/rim engaging force can be obtained with the first bead core 9A which is a 1X5 type bead core, that is, five spiral turns of a 1.20mm dia. bead wire as shown in Fig.2.

It is however, necessary to set the cross sectional area of the second bead core 9B larger than that of the first bead core 9A in order to withstand the cord tension of the carcass ply 6A when the tyre is inflated.

In this embodiment, the second bead core 9B is a 4X5 type bead core, that is, four plies of five spiral turns of a bead wire. The sectional shape thereof is generally a rectangle. Accordingly, the ratio (S2/S1) of the cross sectional area S2 of the second bead core 9B to the cross sectional area S1 of the first bead core 9A becomes about 4.

The diameter of the bead wire of the first bead core is the same as the second bead core. However, the diameters can be differed.

In the first and second bead cores 9A and 9B, the wound bead wire can be wrapped by a sheet of rubber or a sheet of rubberised cords.

Between the first bead core 9A and the second bead core 9B, a buffer rubber layer 10 is disposed.

The carcass ply 6A is secured to the second bead core 9B with the carcass cords extending through between the radially inner surface of the second bead core 9B and the buffer rubber layer 10. Accordingly, the second bead core 9B is pulled radially outward when the tyre is inflated. Therefore, the buffer rubber layer 10 radially outside the first bead core 9A is not subjected to a large compressive force, whereas the rubber located radially inside the first bead core 9A is subjected to a large compressive force. Accordingly, the buffer rubber layer 10 is able to absorb vibration of the carcass ply 6A. As a result, the road noise can be greatly reduced.

The thickness (t) of the buffer rubber layer 10 measured in the radial direction in a tyre meridian section, that is, the distance between the first bead core 9A and the carcass ply 6A, is preferably set in the range of from 2 mm to 6 mm. This is based on test results which are summarised in Fig.3 in which test the reduction in the overall road noise was measured by changing the thickness (t). From the test, it was confirmed that a remarkable reduction of more than 1 dB(A) can be obtained when the thickness (t) exceeds 2 mm. But, when the thickness (t) exceeds 6 mm, no real effect on further reducing the road noise can be obtained. Thus, the thickness (t) of the buffer rubber layer 10 is set in the range of from 2 to 6 mm, more preferably 2 to 5 mm, still more preferably 4 to 5 mm. In the case of a 185/65 tyre, the thickness (t) is set in the range of 2 to 4 mm.

The buffer rubber layer 10 is preferably made of a rubber composition having a complex elastic modulus E^* of from 20 to 100 kgf/cm^2, more preferably 20 to 70 kgf/cm^2, still more preferably 20 to 40 kgf/cm^2. This is based on the results of a test shown in Fig.4 in which test the road noise level was measured by changing the complex elastic modulus E^* of the buffer rubber layer while maintaining the thickness (t) at a constant value of 2 mm.

When the complex elastic modulus E^* is less than 20 kgf/cm^2, the rigidity of the layer excessively decreases, and the stability is liable to decrease when the tyre is mounted on a rim. When more than 100 kgf/cm^2, the rigidity of the bead portion 4 excessively increases and the layer becomes liable to transmit the vibration.

In the above-mentioned tests, the road noise was measured using a 1800cc FF passenger car provided on all wheels with test tyres of size 185/65R14. It was run on a dry rough asphalt road at a speed of 60 km/hr, and the overall noise level was measured using a microphone set near the outside ear of the driver.

Here, the above-mentioned complex elastic modulus E^* is measured with a viscoelastic spectrometer made by Iwamoto Seisakusyo. The conditions are as follows.

Size of specimen: 4 mm width X 30 mm length X 1.5 mm thickness

Temperature:	70 degrees C
Frequency:	10Hz
Dynamic deformation:	+-2%

Further, it is preferable that the JIS(A) hardness of the buffer rubber layer 10 at 20 degrees C is set in the range of from 65 to 80 degrees. When the JIS(A) hardness of the buffer rubber layer 10 is less than 65 degrees, there is a tendency for the bead portion 4 to lack rigidity. When the hardness is more than 80 degrees, the buffer rubber layer 10 can not fully absorb the vibration, and the effect to reduce the road noise decreases.

Each of the bead portions 4 is further provided with a bead apex 11 extending and tapering radially outward from the radially outside of the second bead core 9B. The bead apex 11 is made of a hard rubber having a JIS(A) hardness of from 65 to 95 degrees.

Furthermore, each of the bead portions 4 is provided with a bead reinforcing layer 12 composed of a ply of organic fibre cords, e.g. nylon, rayon, polyester or the like embedded in rubber in a parallel formation.

As shown in Fig.2, the reinforcing cord layer 12 is composed of a base portion 12c, an axially inner portion 12i and an axially outer portion 12o, and it is has a U-shaped cross section. The base portion 12c extends along the radially inside of the first bead core 9A. The axially inner portion 12i extends radially outward from the axially inner end of the base portion 12c along the axially inside of the first bead core 9A and reaches to the axially inside of the second bead core 9B. The axially outer portion 12o extends radially outward from the axially outer end of the base portion 12c along the axially outside of the first bead core 9A and reaches to the axially outside of the second bead core 9B.

It is preferable that each axial portion 12i, 12o terminates at a position radially outward of the radially outermost end of the second bead core 9B. Thus, the inner portion 12i and outer portion 12o partially cover the axially inner surface of the carcass ply main portion 6a and the axially outer surface of the carcass ply turned up portion 6b, respectively. As a result, the separated first and second bead cores 9A and 9B are bound with each other and provided with unity in the tyre axial direction. Therefore, the bead portion 4 is improved in rigidity in the tyre axial direction. The organic fibre cords of the reinforcing cord layer 12 are laid at angle of from 0 to 70 degrees with respect to the radially direction. In view of reinforcement of the bead portion, a 0 to 50 degrees range is more preferable.

As modifications of this embodiment, the number of the bead wire, the number of ply and the number of turns in each ply, in the first and second bead cores 9A and 9B and the section shape thereof can be changed. Further, the number of the carcass ply turned up around the second bead core 9B can be increased to two for example. Furthermore, the direction of turnup can be reversed.

Now another embodiment of the present invention will be described, wherein the same structure or parts as the above-mentioned first embodiment are assigned the same references and the descriptions thereof are not repeated here.

In this embodiment, as shown in Fig.5, a plurality of carcass plies, in this example two plies 6i and 6o extending between the bead portions 4 (4A and 4B) are provided.

In one bead portion 4A, the innermost carcass ply 6i is turned up around the first bead core 9A from the axially inside to outside of the tyre to be secured thereto, while the outermost carcass ply 6o is turned up around the second bead core 9B from the axially inside to outside of the tyre to be secured thereto.

Each carcass ply 6i, 6o is made of organic fibre cords arranged radially at an angle of from 65 to 90 degrees with respect to the tyre equator C. In this embodiment, the angles are set nearly 90 degrees so that those plies slightly cross each other.

The radially outer end 6S of the turnup portion of the innermost carcass ply 6i is positioned radially outward of the radially outermost end of the second bead core 9B to obtain a similar effect to the above-mentioned reinforcing cord layer 12, that is, an axial unity of the first and second bead cores 9A and 9B.

With respect to the modulus of carcass ply cord at 5% elongation, the outermost carcass ply 6o is set higher than the innermost carcass ply 6i to effectively reinforce the tyre main body and relatively decrease the vibration transmission rate of the innermost carcass ply 6i.

The ratio (M1/M2) of the modulus M1 at 5% elongation of the outermost carcass ply 6o cords to the modulus M2 at 5% elongation of the innermost carcass ply 6i cords is preferably set in the range of from 1.2 to 3.0.

If the ratio (M1/M2) is less than 1.2, the road noise reducing effect decreases. If the ratio (M1/M2) is more than 3.0, the tyre uniformity is liable to be deteriorated.

The reason why the modulus at 5% elongation is used is that the actual elongation of the carcass cord under normal service conditions is about 5%.

In general, as the cord tension of a carcass ply increases, the vibration transmission rate and natural frequency of the carcass ply increase, and the road noise also increases. The larger the cord modulus, the larger the cord tension. Therefore, when the tyre is inflated, the cord tension of the higher modulus cord ply becomes larger and vibration is transmitted easier than in the lower modulus cord ply.

In this embodiment, therefore, the outer ply 6o is secured to the outer bead core and the inner ply 6i is secured to

the inner bead core. Accordingly, the vibration decreases between the outer and inner bead cores.

In this embodiment, as the innermost carcass ply 6i is secured to the first bead core 9A, the ratio (S2/S1) of the cross sectional area S2 of the second bead core 9B to the cross sectional area S1 of the first bead core 9A is set to be less than that in the above-mentioned first embodiment, and usually set in the range of from 1.2 to 3.0.

On the contrary, the other bead portion 4B is provided with a single bead core 13 as shown in Fig.5.

The bead core 13 is disposed at a radial height corresponding to that of the first bead core 9A, and the cross sectional area thereof is set to be larger than that of the second bead core 9B so as to keep the rigidity balance between the right and left bead portions 4A and 4B. In the bead portion 4B, therefore, the inner and outer carcass plies 6i and 6o are turned up around the bead core 13 from the axially inside to outside of the tyre to be secured thereto.

In the bead cores 9A, 9B and 13 in this embodiment, a round sectional shape is used. It is however, possible to use other shapes.

Fig.6 shows a modification of the double core bead portion 4A, wherein the first and second bead cores 9A and 9B have rectangular sectional shapes with different radial heights h1 and h2, and the second bead core 9B is disposed such that the radially inside thereof is located at substantially the same height as the radially outer edge of the rim flange F.

Fig.7 also shows a modification of the double core bead portion 4A, wherein the second bead core 9B overhangs the rim flange F, which is effective in preventing tyre dislocation from the rim.

As further modifications of the second embodiment, it is possible to dispose at least one ply between the inner and outer plies, which is turned up around one of the bead cores 9A and 9B or not turned up. Further, it is possible to employ the double bead core structure of the bead portion 4A in the other bead portion 4B so that the tyre has a symmetrical structure.

Incidentally, the asymmetrical tyre shown in Fig.5 is preferably installed such that the double core bead portion 4A is located on the outside of the car, and accordingly the single core bead portion 4B is located on the inside of the car.

COMPARISON TESTS

I. First Embodiment

Test tyres of size 185/65R14 were made by way of test and the road noise was measured. The test tyres included Ex. tyres 1 to 10 having the structure shown in Figs.1 and 2 and Ref. tyre 1 having the conventional structure shown in Fig.8. A 1800cc FF passenger car provided on all wheels with test tyres was run on a test course at a constant speed of 60 km/hr, and the overall noise level in dB(A) was measured as the road noise by a microphone set near the driver's ears. The specifications thereof and test results are shown in Table 1.

In the test, it was confirmed that the Example tyres were greatly improved in road noise in comparison the with Reference tyre. The road noise reduction became less when the thickness of the buffer rubber layer was less than 2 mm (Embodiment 9), or the complex elastic modulus thereof was more than 100 kgf/cm^2 (Embodiment 10).

II. Second Embodiment

Test tyre of size 185/70R14 88S were made by way of test and the road noise and resistance to bead unseating were measured. The test tyres included Ex. tyre 11 to 16 having the tyre structure shown in Figs.5 and 6 and Ref. tyre 2 having the conventional tyre structure shown in Fig.8.

In the bead unseating test, mounting the test tyre on a standard rim, and applying a force to one of the bead portions from the outside of the tyre, the force at which unseating of the bead portion from the rim occurred was measured.

The results are indicated by an index based on that Ref. 2 is 100. The larger the value, the higher the resistance. The tyre specifications and test results are shown in Table 2.

From the test, it was confirmed that Example tyres 11 to 16 were decreased in road noise in comparison with Reference tyre 2. In comparison with Example tyre 6 of which inner and outer carcass plies were made of cords having the same modulus at 5% elongation, other Example tyres made of different modulus cords were more improved in the road noise.

The road noise was further improved by decreasing the hardness of the buffer rubber layer (Example tyres 12 and 13) and/or increasing the modulus ratio (M1/M2) (Example tyres 13 and 14).

As described above, in the pneumatic tyres according to the present invention, the transmission of carcass vibration to the radially inner bead core is effectively decreased, as a result the road noise can be greatly reduced.

TABLE 1

Tyre	Ex.1	Ex.2	Ex.3	Ex.4	Ex.5	Ex.6	Ex.7	Ex.8	Ex.9	Ex.10	Ref.1
Bead structure	Fig.2	Fig.2	Fig.2	Fi.g2	Fig.2	Fig.2	Fig.2	Fig.2	Fig.2	Fig.2	Fig.8
First bead core											non
Wire dia. (mm)	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	--
Structure	1X5	1X5	1X5	1X5	1X5	1X5	1X5	1X5	1X5	1X5	--
Second bead core											
Wire dia. (Mm)	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Structure	4X5	4X5	4X5	4X5	4X5	4X5	4X5	4X5	4X5	4X5	5X5
Buffer rubber layer											non
Thickness (t) (mm)	2	2	2	2	4	5	4	4	1	2	--
E* (kgf/cm²)	20	40	70	100	70	70	20	100	70	150	--
Bead reinforcing layer	exist	exist	exist	exist	exist	exist	exist	exist	exist	exist	--
Road noise dB(A)	73.1	73.4	73.9	74.5	73.3	73.1	72.5	73.8	74.8	74.9	75.1

TABLE 2

Tyre	Ex.11	Ex.12	Ex.13	Ex.14	Ex.15	Ex.16	Ref.2
Carcass							
Outer ply cord *1)	A	A	A	A	A	A	A
Inner ply cord *1)	B	B	B	C	C	A	A
Modulus ratio (M1/M2)	1.50	1.50	1.50	2.41	2.41	1.0	1.0
Bead portion	Fig.5	Fig.5	Fig.5	Fig.5	Fig.7	Fig.5	Fig.8
Buffer rubber layer JIS-A hardness	90	80	70	70	70	70	-
Road noise dB(A)	68.7	68.5	68.3	68.0	68.2	68.0	69.1
Bead unseating (index)	105	102	101	101	110	101	100

*1) All the carcass lies were the same cord count. (35/5cm)
Cord A: polyester cord, 5% modulus 6.75kgf
Cord B: polyester cord, 5% modulus 4.5 kgf
Cord C: nylon 6-6 cord, 5% modulus 2.8 kgf

Claims

1. A pneumatic tyre comprising a tread portion (2),a pair of sidewall portions (3), a pair of bead portions (4,4A,4B), characterised by a radially inner bead core (9A) disposed in at least one of the bead portions (4,4A), a radially outer bead core (9B) disposed radially outside the inner bead core (9A), a buffer rubber layer (10) disposed between the radially inner bead core (9A) and radially outer bead core (9B) to provide a predetermined space therebetween, and a toroidal carcass (6) extending between the bead portions through the tread portion and sidewall portions, the carcass comprising a ply of cords turned up around the radially outer bead core (9B) to be secured thereto, passing between the radially outer bead core (9B) and the buffer rubber layer (10), so that radially outward tension of the carcass caused by tyre inflation acts on the radially inner bead core (9A) than the radially outer bead core (9B).

2. A pneumatic tyre according to claim 1, characterised in that the thickness of the buffer rubber layer (10) measured in the radial direction of the tyre is in the range of from 2 to 6 mm.

3. A pneumatic tyre according to claim 1 or 2, characterised by a bead apex (11) made of a hard rubber tapering radially outwardly from the radially outside of the radially outer bead core (9B), and a reinforcing layer (12) being made of rubberised organic fibre cords, the reinforcing layer (12) composed of a base portion (12c) located radially inside of the inner bead core (9A), an axially inner portion (12i) extending radially outwardly from the axially inner end of the base portion, and an axially outer portion (12o) extending radially outwardly from the axially outer end of the base portion and each of the axially inner and outer portions (12i,12o) of the reinforcing layer has a radially outer end located radially outside of the radially outer end of the second bead core so as to extend along the axially inner and outer surfaces, respectively, of the carcass ply which is turned up around the second bead core.

4. A pneumatic tyre according to claim 2 or 3, characterised in that said carcass further comprises an inner ply (6i) of cords disposed inside said ply and turned up around the radially inner bead core.

5. A pneumatic tyre according to claim 3, characterised in that the outer carcass ply (6o) is higher in modulus at 5% elongation than the inner carcass ply (6i).

6. A pneumatic tyre according to claim 5, characterised in that the ratio between the modulus at 5% M1 of the outer carcass ply (6o) and the modulus at 5% M2 of the inner carcass ply (6i) is in the range of 1.2 to 3.0.

7. A pneumatic tyre according to any of claims 1 to 6, characterised in the ratio (S2/S1) of the cross sectional area S1 of the first bead core (9A) to the cross sectional are of the second bead core (9B) is in the range of 1.2 to 3.0.

8. A pneumatic tyre according to any of claims 1 to 7, characterised in that the first bead core (9A) and the second bead core (9B) are disposed such that the second bead core (9B)is located at substantially the same radial height as the radially outer edge of the rim flange F on the wheelrim for which the tyre is intended.

9. A pneumatic tyre according to any of claims 1 to 7, characterised in that the first bead core (9A) and the second bead core (9B) are disposed such that the second bead core (9B) is located radially outside the radially outer edge of the rim flange F on the wheelrim for which the tyre is intended.

10. A pneumatic tyre according to claim 9, characterised in that the second bead core (9B) is positioned axially outwards of the first bead core (9A) so as to overlay the flange (F) of the wheelrim for which the tyre is intended.

11. A pneumatic tyre according to any of claims 1 to 10, characterised in that the buffer rubber layer (10) has a complex elastic modulus E^* in the range of 20 to 100 kgf/cm^2.

12. A pneumatic tyre according to any of claims 1 to 10, characterised in that the buffer rubber layer (10) has a complex elastic modulus E^* in the range of 20 to 40 kgf/cm^2.

13. A pneumatic tyre according to any of claims 1 to 12, characterised in that both beads of the tyre have the same construction.

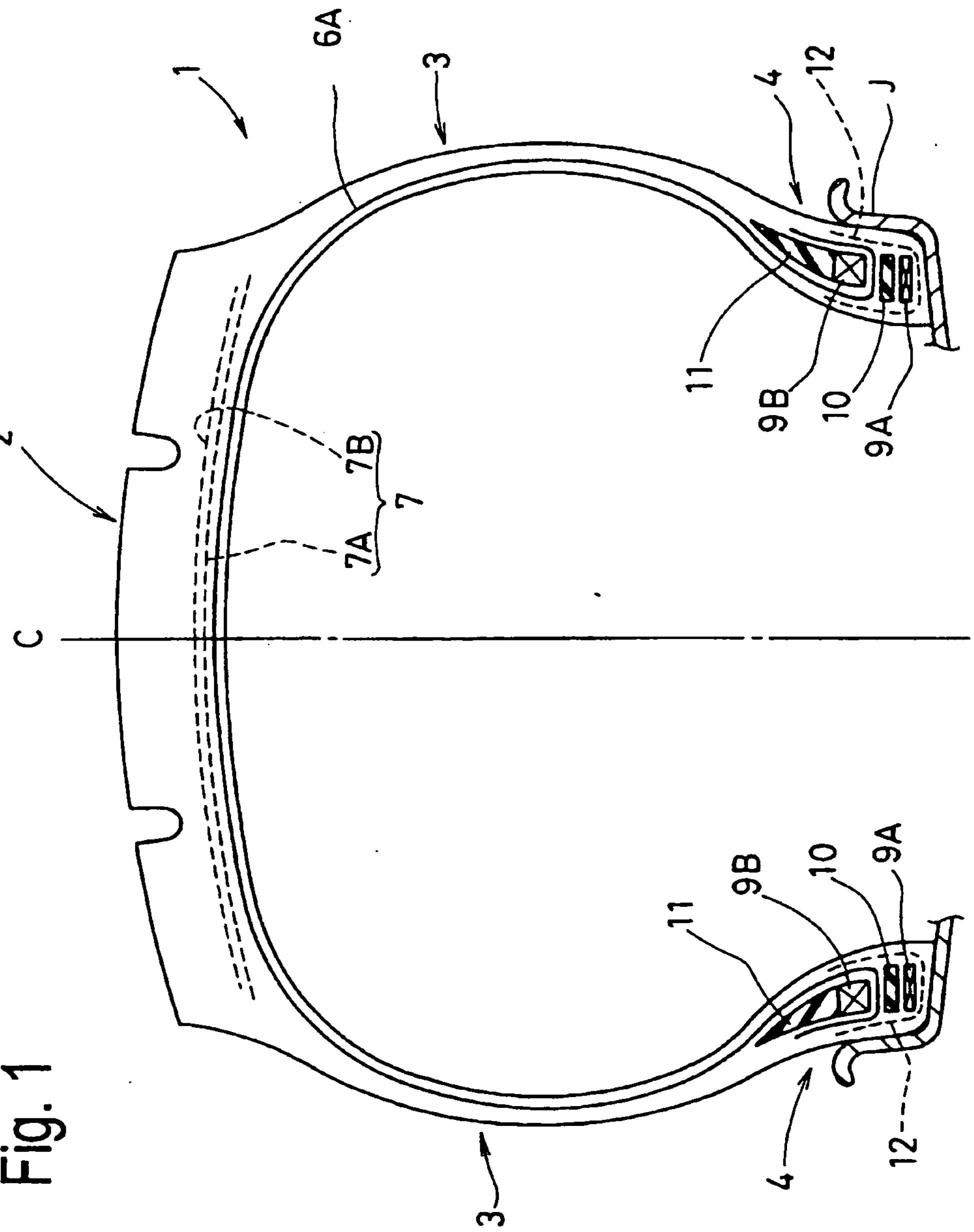


Fig. 1

Fig. 2

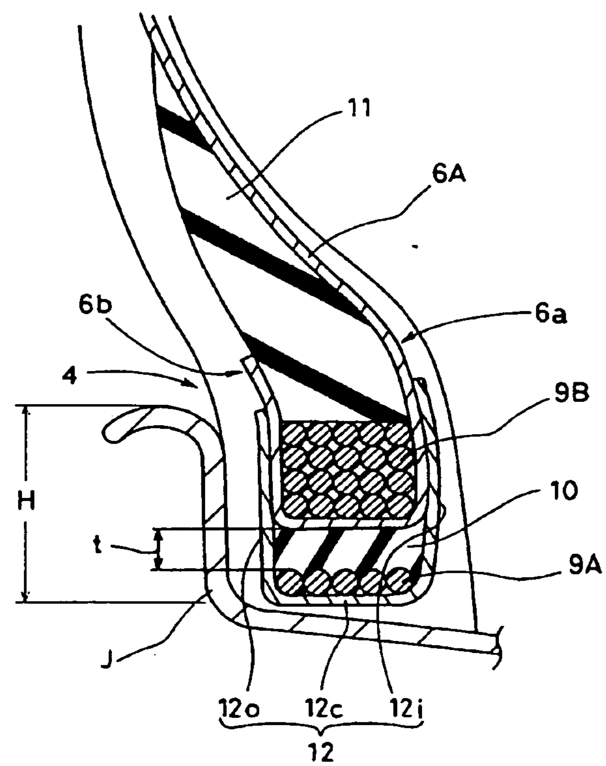


Fig. 3

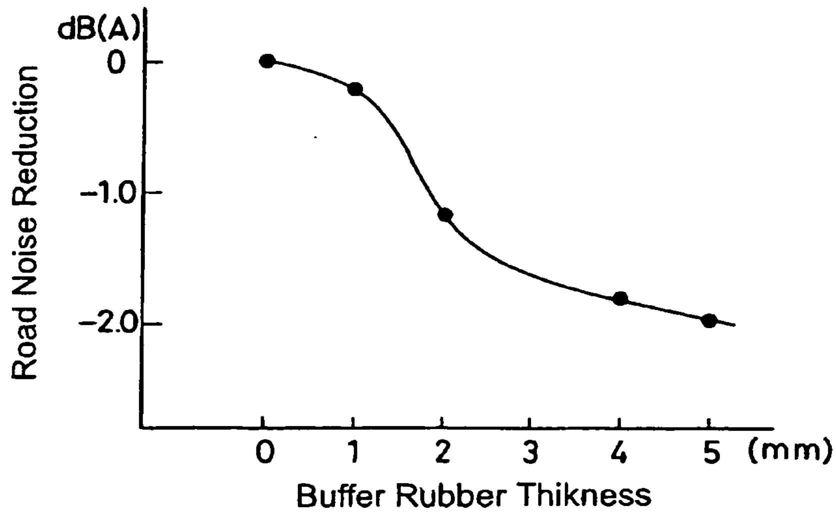
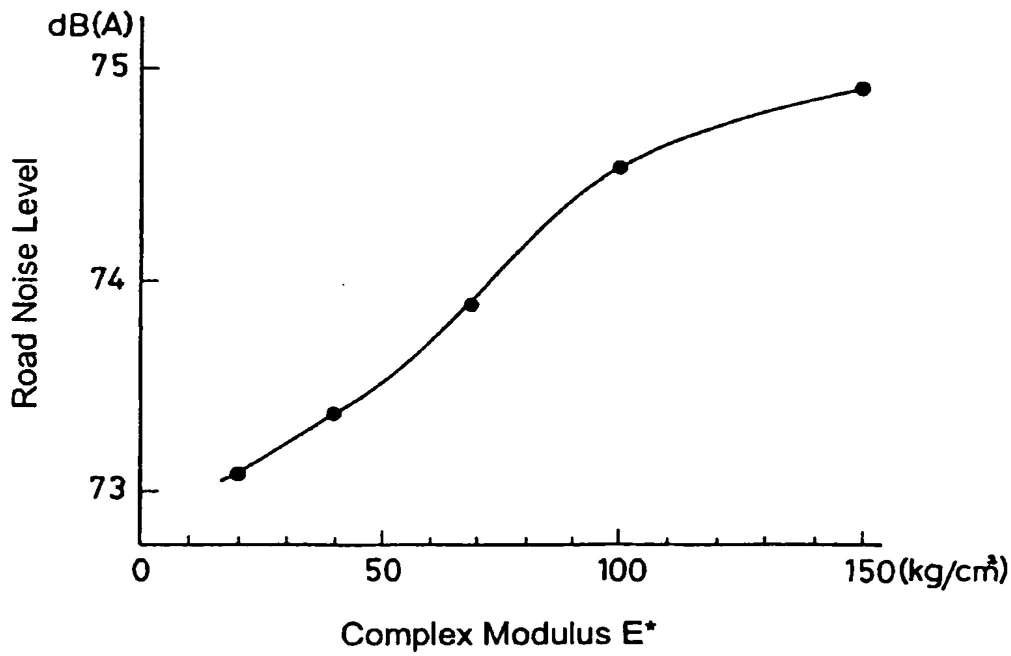

dB(A)
0
-1.0
-2.0
Road Noise Reduction
0
1
2
3
4
5
(mm)
Buffer Rubber Thikness

Fig. 4


dB(A)
75
74
73
Road Noise Level
0
50
100
150(kg/cm²)
Complex Modulus E*

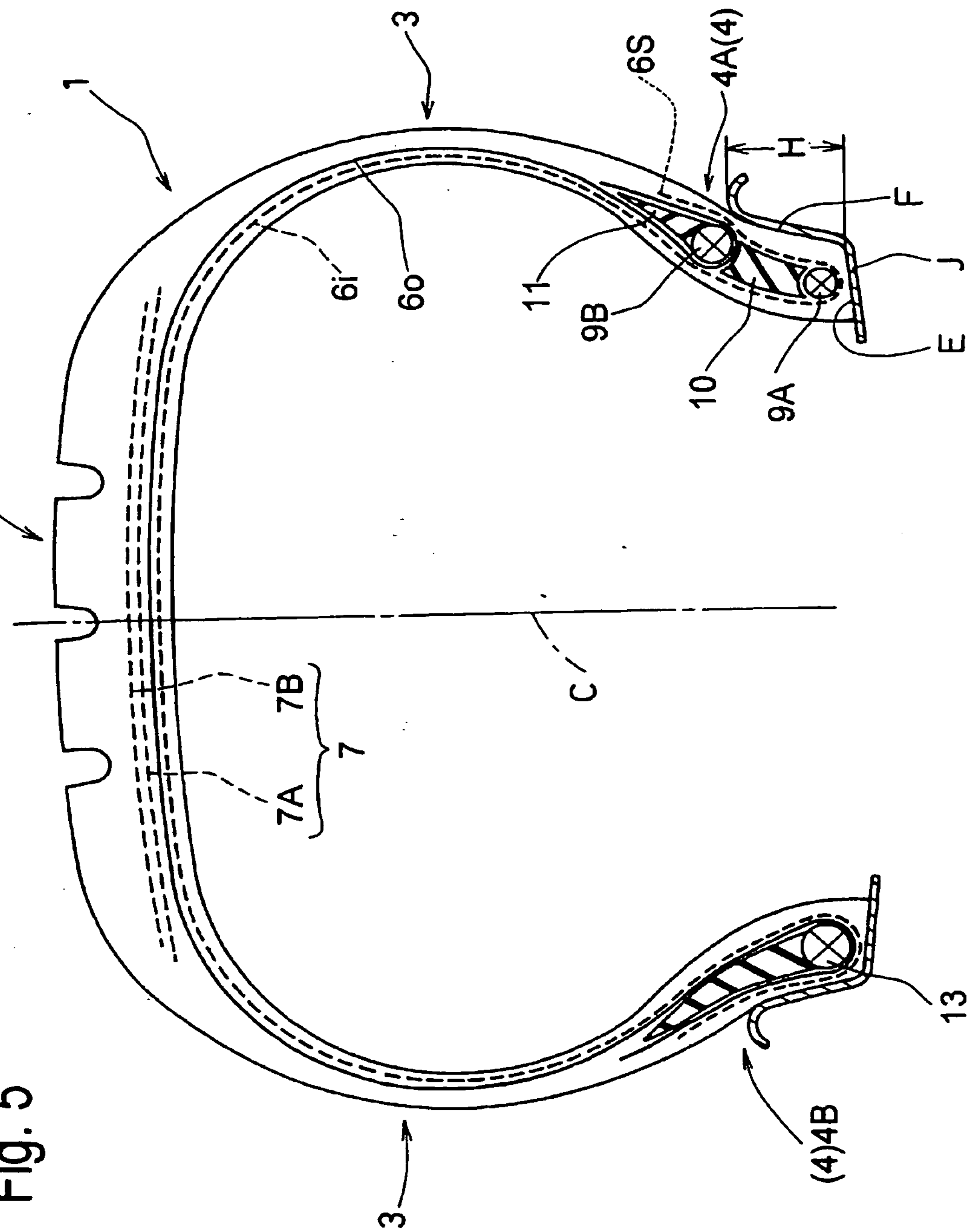


Fig. 5

Fig. 6

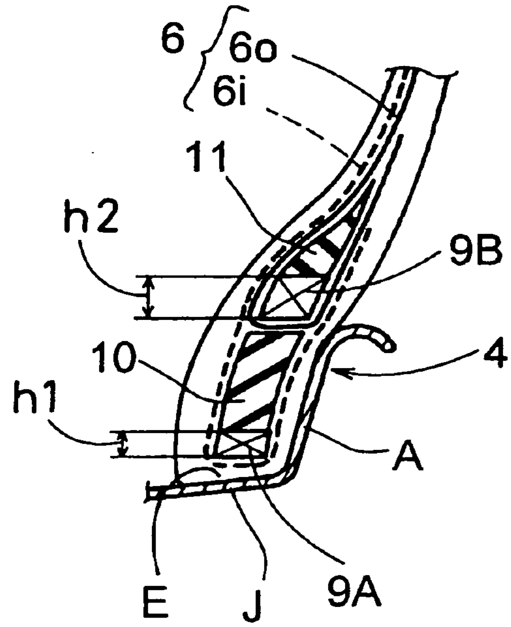


Fig. 7

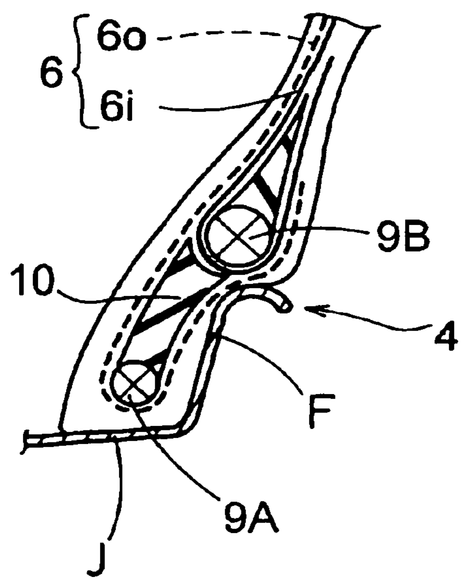
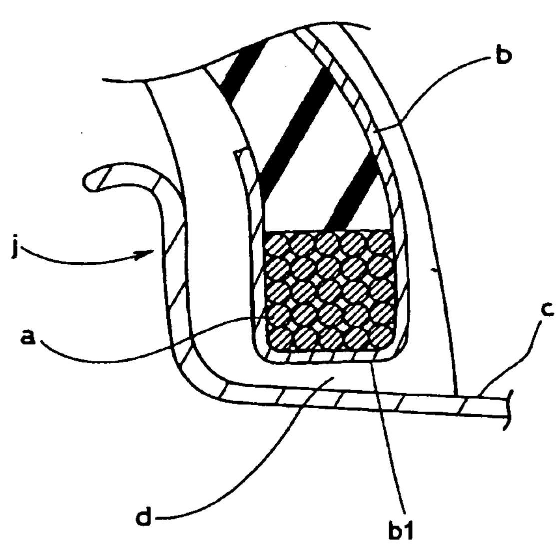


Fig. 8



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EUROPEAN SEARCH REPORT

Application Number
EP 96 30 7614

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X	EP-A-0 634 297 (MICHELIN) * column 2, line 30-34 - column 4, line 24 * * column 5, line 10 - column 6, line 50 *	1,3, 8-10,13	B60C15/05 B60C15/024
X	EP-A-0 168 754 (MICHELIN) * page 4, line 19 - page 6, line 11 * * page 6, line 21 - page 7, line 31 *	1,3,4	
A	FR-A-2 433 425 (DUNLOP) * page 3, line 21 - page 4, line 13 * * page 5, line 28 - page 5, line 7 * * page 7, line 20-27 *	1	
A	WO-A-92 01577 (MICHELIN) * the whole document *	1	

TECHNICAL FIELDS SEARCHED (Int.Cl.6)
B60C

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	29 January 1997	Schmitt, L

CATEGORY OF CITED DOCUMENTS

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